HANN'S NEW METEOROLOGY.

Those of our readers who are familiar with the German language will be pleased to know that the first number of the new Lehrbuch der Meteorologie, by Prof. Dr. Julius Hann, has been received. The whole work will include about eight parts or 700 pages royal octavo. The principal text, in large type, is accompanied by almost as much matter in smaller type, and again as much more by way of foot notes in still smaller type. The appendix will consist of chapters in mathematical physics explanatory of the problems whose general results are given in the text. The whole volume consists of five subdivisions on temperature, pressure, aqueous vapor, the winds, and the atmospheric disturbances. On every page one sees evidence that the author has determined to present only the latest or best established views, and especially the results of accurate measurements instead of indefinite general views. The work represents the present state of scientific meteorology as contrasted with the popular and more readable books that have been published for general use. The price of the whole volume will be about $6. If there is a sufficient demand for an English translation, we believe that the Chief of Bureau will be pleased to provide it, although it may include only a portion of the present work.

THE RELATIVE DURATION OF THE NORMAL WARM AND COLD SEASONS.

The agriculturist understands by the term growing season the interval between the date of the sprouting of his recently sown seed and the date of the ripening of the harvest. The botanist understands by the growing season the interval between the appearance of the earliest buds or flowers in the springtime and the fall of the leaf in autumn. Both of these phenological periods depend quite as much on moisture as they do on temperature: not only must the temperature be above freezing, and in fact generally above 42° F., but there must be enough moisture in the soil to supply the sap necessary for growth. Linnsser has demonstrated that as we proceed eastward from the coast of Europe into the dry region of southern Russia, the plants have, by the process of natural selection, eliminated from among themselves those that can not adapt themselves to their surroundings, so that in southern Russia the early spring with its showers brings forth a fine crop of cereals and other plants, which very rapidly perfect their seeds so that the harvest is over before the long summer drought begins. A similar process of adaptation will undoubtedly go on as Americans continue the cultivation of the plains on the eastern slope of the Rocky Mountains in Mexico, the United States, and Canada. Already the development of "short season" wheat and corn is noticeable. We are, therefore, interested in the relations between the warm and cold portions of the year brought out by Mr. Pennywitt in his article on a previous page, and shown on Charts XI to XIII.

The mean daily temperatures employed by Mr. Pennywitt are the means of the daily maxima and minima. Now the maximum temperatures are the resultant of the sun's heat plus the effect of the winds, the clouds, and the radiation from the earth's surface, but the minimum temperatures are mainly the result of the radiation, the winds and the clouds, with but very little of the direct influence of sunshine. Therefore, as the maximum temperatures might be expected to show the influence of the progress of the sun northward in the springtime, or southward in the autumn, much more clearly than the daily minimum temperatures, so also the daily average of the maxima and minima should show this progress less clearly. Charts of the dates on which the normal daily maxima equal the normal annual mean of the maxima would be especially interesting from an agricultural point of view, since most plants depend for their growth and ripening on the direct action of the sun's rays.

Charts showing when the normal mean daily temperatures cross the line of 42° F. would be of special interest because the latter temperature has been taken as the basis for computing the sum total of the degrees usually adopted as a thermal constant in phenological studies.

THE WEATHER IN DISTANT REGIONS.

During the month of February special phenomena were reported about as follows:

February 3–6.—Severe gales off the coast of Virginia and North Carolina and very heavy weather between New York and Bermuda, as well as Halifax and Bermuda.

February 16, 17.—Intense cold in southern Europe, with high winds, snowstorms, and blizzards; an eruption of Mount Vesuvius; interruption of railroad traffic in southern Russia; heavy gale on the southern coast of Spain; snow slides in Switzerland.

February 1–19.—Remarkable easterly gales for fifteen days on the route between Norfolk, Va., and Queenstown, Ireland.

February 22, 23, 24.—Southern Russia, violent blizzard following a week of snowstorms; great hardships and prospects of a famine owing to the consumption of grain stored up for spring seed. The snowstorms of February 10–15 are reported to have been the fiercest known in forty years.

February 26.—2 a. m., at St. Joseph, Mich., earthquake; three distinct shocks.

February 27, 28.—Dull, unsettled weather in England, Germany, and France, with local rain.

NEW DETERMINATION OF VAPOR TENSION.

According to No. 2 of the Beiblätter for 1901, some new determinations of the vapor tension of saturated aqueous vapor have been made by Dr. Thiesen and K. Scheel and published in volume 3 of the Scientific Memoirs of the Imperial Physical and Technical Institute at Charlottenburg. The adopted value of the vapor pressure at 0° C. is 4.579 millimeters of mercury at 0° C. under normal gravity, with a probable error of ±0.001. For other temperatures the following pressures are found, but with a slightly lower degree of accuracy. These values must be considered as more reliable than the determinations by Regnault and Magnus at the same temperatures:

Temperature. °C.	Pressure. Thiesen and Scheel. *Mm.*
—11.334	1.9217
— 6.561	2.6731
0.0	4.579
+14.5679	12.4385
15.0593	12.8285
16.3603	13.9189
19.8402	17.3622
19.8438	17.3411
24.9749	23.6818
+25.4748	24.3308

The comparison of these values with the empirical formulæ for fluid water and for ice published in Wiedemann's Annalen, Vol. LXVII, page 692, 1899, shows no deviation exceeding $\frac{1}{10}$ millimeter. A translation of this article by Dr. Thiesen was prepared at the time for the MONTHLY WEATHER REVIEW, but the publication has been delayed.

The determinations of the vapor pressure from ice and

water at temperatures below freezing, as made by Marvin and Juhlin in 1891, can hardly be considered as supplanted by these two accurate measurements at —6° and —11° C.

The four decimal places given in the preceding table must not be allowed to produce a false impression as to the absolute accuracy of these figures. We grant that every generation of physicists undoubtedly improves upon the work of its predecessors, and the average accuracy of modern work undoubtedly exceeds that of a hundred years ago in physics as in astronomy; nevertheless, just as the astronomers are continually reverting to the work of Bradley at Greenwich as still being worth combining with the modern measurements, so it seems to us likely that the old determinations of vapor pressure by the physicists may also still be worth combining with the newest values. In every effort at extreme accuracy we find the observer himself enters as a source of disturbance. The accuracy of his eye, the delicacy of his touch, the weight and temperature of his body, his method of handling the apparatus, his nervousness or equanimity, his thoroughness or carelessness, his experience and his knowledge, all come into consideration. After ten good men have each done their best the results are usually combined together into one adopted value by giving to each man's work a weight that expresses approximately our reliance in him individually. The method of least squares not only tells us how to combine observations together, but also how to calculate the average discrepancy of the individual results and the weight that should be given to the final results. This weight is usually expressed as a "probable error," by which we mean that the different measurements harmonize among themselves so well that, unless there be some unknown source of error, the chances are that the given result is correct within a certain limit, but this "probable error" tells us absolutely nothing about the systematic sources of error that the observer may not have thought of. In the above case Drs. Thiesen and Scheel calculate the probable error of the vapor tension at 0° C. to be ±0.001, in other words, so far as they can see, there is an even chance that the vapor tension is somewhere between 4.578 and 4.580. Now, Broch in his reduction of Regnault's observations gives twelve independent determinations of this same vapor pressure at 0° C., viz:

4.680	4.671	4.563	4.544
.651	.591	.527	.685
.571	.611	.540	.658

Each of these is an independent value, sometimes the mean of several. They were determined on different days through a course of several months' work, and with several pieces of apparatus, so that many sources of error may have entered in an irregular way. If we take the simple mean of these values, i. e., 4.6077, and calculate the probable error, we get ±0.0114, in other words there is an even chance that the vapor pressure at 0° C. lies between 4.596 and 4.619. Similarly, Professor Marvin's value has the probable error, ±0.004. The value of the vapor tension over water and over ice must be a more difficult question than would be supposed at first thought, since eminent authorities differ so much from each other, even at the freezing point, where the uncertainty in the value must be much less than the intrinsic uncertainties for higher and lower temperatures where the errors of thermometry are superadded to all the others. As we have not the full memoir of Thiesen and Scheel at hand, and know not the special precautions taken by them in their work, we can, perhaps, best arrive at some idea of our present knowledge of this subject by comparing, side by side, the values of the vapor pressure at 0° C. as given by a number of authorities, as in the following table, where all are supposed to be expressed in millimeters of mercury at 0° C., and under standard gravity.

	Millimeters.	Probable error.
Regnault, observations	4.6077	±0.011
Broch, formula	4.5687	.....
Magnus, observations	4.525	.....
Thiesen, observations	4.579	±0.001
Marvin, observations	4.568	±0.004
Juhlin, water	4.62	.....
Juhlin, ice	4.60	.....

The discordance between these numbers ought to be explained by further investigation into the effects of sources of error that have not yet been recognized, before we can confidently throw aside all previous determinations, and adopt the newest one by the Imperial Institute at Charlottenburg. The fact that there is a range of 0.10 millimeter between the values of vapor tension by different authorities at 0° C. forces one to recognize that even larger discrepancies may be expected at higher and lower temperatures, so that there may be an uncertainty of 1/10 millimeter in our best tables, instead of an accuracy of 1/1000 millimeter, as indicated by the simple "probable error" of the method of least squares, which in fact really ought to be called simply the index to the general variability of any system of measurements.

We have, therefore, computed the exact vapor pressures given by Broch's tables,[1] corresponding to the temperatures of Dr. Thiesen's observations as given, and we have inserted these in the following table for the edification of our readers.

Temperatures.	Vapor pressures.		Difference. Thiesen-Broch.
	Thiesen and Scheel.	Broch.	
° C.	*Mm.*	*Mm.*	*Mm.*
—11.334	1.9217	1.9360	—0.0143
— 6.561	2.6731	2.8081	—0.1350
0.0	4.579	4.5687	+0.010
+14.5679	12.4365	12.3269	+0.1116
15.0593	12.8285	12.7222	+0.1063
16.3606	13.9189	13.8234	+0.0965
19.8402	17.3622	17.1925	+0.1697
19.8438	17.3411	17.1965	+0.1446
24.9749	23.6818	23.4823	+0.1995
+25.4748	24.3308	24.1911	+0.1397

We take some satisfaction in adding that the value given by Thiesen, 4.579^{mm}, and that given by Marvin, 4.568^{mm}, are, in fact, in almost as close agreement with each other as would be required by their probable errors, which latter would justify a discrepancy of 0.005. They are the results of the latest and most painstaking work, and their agreement encourages us to believe that there are but very few and slight causes of error that have not been allowed for by them. Unfortunately the Beiblätter (from which we have necessarily copied the results of Thiesen's measurements) says nothing about the question of the tension of vapor over ice and over water at the temperatures —6° and —11° C. For these temperatures the tensions given by Thiesen are appreciably higher than those given by Marvin for ice, but agree better with his figures for water. On the whole, therefore, the new psychrometric tables of the Weather Bureau (W. B., No. 235) represent our best knowledge of the vapor tensions over water and ice.

[1] In the first volume of the "Travaux" of the International Bureau at Paris.